

June 2001

1. (a) (i) census, electoral register
(ii) sample survey, list
(b) Poisson
2. (a) 0.407 (b) 0.066 (c) 0.3495
3. Insufficient evidence of change
4. (a) 0.3222 (b) 0.3578 (c) 0.3264
5. (a) 0.0902 (b) 0.0166 (c) 0.4457
6. (a) $f(x) = \frac{1}{27}(-3x^2 + 12x)$ (b) 2 (d) 2.25
(e) $F(2.25) = 0.517$
7. (a) 0.2 (b) 0.5 (c) $\frac{1}{12}$ (d) 0.6296 (g) 0.256

January 2002

1. (a) Collection of individuals
(b) rv that is a function of known observations from a population
(c) College students. Mean approval rating 75%
(d) distribution of all possible means of sample size 50
2. $H_0: \lambda = 2.5, H_1: \lambda > 2.5, P(x \geq 14) = 0.1355, \text{ Do not reject } H_0$
3. (a) Bin (200, 0.03) (b) 0.1512 (c) 0.7149
4. (a) U[0, 14] (b) 8.02 a.m. (c) $F(x) = \begin{cases} 0, & x < 0 \\ \frac{x}{14}, & 0 \leq x \leq 14 \\ 1, & x > 14 \end{cases}$

(d) $\frac{2}{7}$

5. Singly, independently, constant rate, random, rare event
(b) (i) 0.0498 (ii) 0.1847 (c) Po(24) (d) 0.9946
6. (a) Bin (20, 0.4) (b) 0.8728 (c) 8, 219
(d) $H_0: \rho = 0.4, H_1: \rho > 0.4, P(x \geq 8) = 0.0123, \text{ Reject } H_0$
7. (a) $8k = 1, k = \frac{1}{8}$ (b) 1.236
(c) $F(x) = \begin{cases} \frac{1}{4}(x+1), & 0 \leq x \leq 2 \\ 0, & \text{otherwise} \end{cases}$
(e) 2 (f) $\frac{7}{6}$ (g) negative skew

June 2002

2. (b) $Y = \bar{X} = \frac{\sum x}{n}$
3. (a) $\alpha = -2, \beta = 8$ (b) 0.86
4. (a) Critical value = 0.0982, do not reject H_0
(b) $Y \leq 3$ and $Y \geq 16$ (c) 0.0432
5. (a) $\mu = 150.5 \text{ cm}$ (b) 0.9885
(c) ≈ 0.9744 or 0.9713
6. (a) 0.0470 (b) 0.41082 (c) ≈ 0.6536
7. (b) (i) $\frac{x^2}{30}$ for $0 \leq x \leq 2$; $\frac{4x}{9} - \frac{x^2}{45} - \frac{11}{9}$ for $7 \leq x \leq 10$

(ii) $\frac{2x}{15} - \frac{2}{15}$ for $2 \leq x \leq 7$

(iii) $F(x) = 0, x < 0; F(x) = 1, x > 10$ (c) 0.928

(d) 4.78

January 2003

1. (a) Continuous uniform (Rectangular), $U(-0.5, 0.5)$ (b) 0.4
(c) 0.16
2. (a) $(X \leq 2) \cup (X \geq 13)$ (b) 0.0566
3. (b) 0.469 (c) 0.6628
4. (a) 0.4267 (b) $\frac{4x}{3}(2-x^2)$ for $0 \leq x \leq 1$ (c) 0.057 (d) -0.812
5. (a) 0.3412 (b) 0.0022 (c) 0.0230 (d) 0.1528 (e) 0.1056
6. (e) 0.1612 (g) 0.5553

June 2003

2. (a) λ is large or $\lambda > 10$ (b) 0.607
3. (a) $X \sim B(4, 0.3)$ (c) 1 resident
(d) $E(X) = 1.2; \text{Var}(X) = 0.84$
4. (b) (i) 0.0531 (ii) 0.243
5. (b) (i) 0.15 (ii) 0 (c) 10 (d) $186\frac{2}{3}$
6. (b) 0.5665

7. (b) $-\frac{1}{4}$ (d) 0.657

January 2004

2. (a) 0.65333 (b) 0.2469 (c) 0.0808
3. (a) $\frac{1}{2}$ (c) 0.7055 - 0.7070
4. (a) n large, p small (b) 0.0027 (c) 0.3134
5. (b) 0.1066 (c) 0.4769
6. (a) $X \leq 1, X \geq 10$ (b) 0.0447
7. (b) $(0, \frac{x^2}{112}(15-2x), 1)$ (c) 2.29 (d) 2.5

June 2004

2. (a) 0.74 (b) 1.5 (c) 2.083
3. Insufficient evidence to support claim. Do not reject
4. (c) 0.1216 (d) 0.0024 (e) Mean = 2; Variance = 1.8
(f) 0.0487
5. (b) 0.9907 (c) 0.9473
6. (b) 0.2510 (c) 0.0045 (d) 0.1867
7. (a) 1.27

$$(b) F(x) = \begin{cases} 0 & x < 0 \\ \frac{1}{3}x & 0 \leq x < 1 \\ \frac{1}{45}(2x^2 + 13) & 1 \leq x \leq 2 \\ 1 & x > 2 \end{cases}$$

(c) 1.48 (d) Mean < median; negative skew

(c) 0.933

January 2005

1. (a) 0.2061 (b) 0.1093 (c) 0

3. (b) $\frac{1}{3}$ (c) $\frac{1}{2}l$ (d) $\frac{1}{9}$

4. (b) $\alpha = 0.01$; CR: $z = 2.3263$; $np = 25$; $npq = 22.5$
 $z = 3.0568$ – reject H_0 , claim cannot be accepted

5. (a) 0.0355 (b) 0.603 (c) 0.0294

6. (a) 0.1847 (b) 0.9450

7. (b) $\frac{5}{2}$ (c) $\frac{5}{2}$ (e) 0.5

(f) median = 2.5; Distribution is symmetrical

June 2005

1. (a) 125 (b) 1.70

2. (a) 0 (b) 4 (c) $\frac{4}{3}$ (d) $1, x > 6; 0, x < 2$
 (e) 0.275

3. (b) 0.0821 (c) 0.1334 (d) 0.07

5. (a) 0.1563 (b) 0.6288

6. (b) $\frac{16}{15}$ (c) $\frac{2}{\sqrt{3}}$ (d) 1.08 (e) negative skew

7. (a) $X \sim B(10, p)$ (b) 0.1460
 (c) Doctor's belief not supported by sample (d) 9

January 2006

1. (a) 0.375 (b) 0.125 (c) 0.125

2. (a) $X \sim \text{Po}(1.5)$ (b) 0.2510 (c) 0.4689 (d) 0.1847

3. (b) 2 (c) 3 (d) 0.6

4. 0.0119

5. (b) 2.69 (c) $\begin{cases} 0 & x \leq 2 \\ \frac{1}{4}(x^3 - 3x^2 + 4) & 2 < x < 3 \\ 1 & x \geq 3 \end{cases}$

6. (a) 0.02; 0.0002
 (b) (1,1); (1, 2) and (2, 1); (1, 5) and (5, 1)

(2, 2); (2, 5) and (5, 2); (5, 5)

(c)

\bar{x}	1	1.5	2	3	3.5	5
$P(\bar{X} = \bar{x})$	$\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{3} \times \frac{1}{3} = \frac{1}{9}$	$\frac{1}{6}$	$2 \times \frac{1}{3} \times \frac{1}{6} = \frac{1}{9}$	$\frac{1}{36}$

June 2006

1. (a) 125 (b) 1.70
2. (a) 0.175 (b) $\frac{1}{4}$ (c) 0.9861
3. (a) $X \sim \text{Po}(7)$ (b) 0.1277 (c) 0.1492
4. (a) 0.868467...
5. (b) 0.016808... (c) (i) 0.2020 (ii) 0.2147
6. (b)
$$\begin{cases} 0 & x < 1 \\ \frac{x^2 + 2x - 3}{21} & 1 \leq x < 4 \\ 1 & x \geq 4 \end{cases}$$
 (c) 2.7142
(d) 2.8078 (e) 4 (f) Mean < Median
7. (a) $\{X \leq 1 \cup X \geq 10\}$ (b) 4.477%

January 2007

1. (b) (i) Yes, (ii) No
2. (a) 0.0081 (b) 0.00392

3. (a) 0.2225 (b) 0.261 (c) 0.257 (d) 0.198

4. (a) $\lambda > 10$ (c) 0.125 (d) 0.136 (e) $2.17 \Rightarrow 2$ or 3

5. (a) $f(x) = \begin{cases} \frac{1}{\beta - \alpha}, & \alpha < x < \beta \\ 0, & \text{otherwise} \end{cases}$

(b) $\alpha = -2, \beta = 6$ (c) 75 cm (d) 43.3 cm (e) 0.4

6. (b) critical region: $Y = 0 \cup Y \geq 9$ (c) 0.04

7. (a) 0.847 (c) $f(x) = \begin{cases} -3x^2 + 4x, & 0 \leq x \leq 1 \\ 0, & \text{otherwise} \end{cases}$

(d) 0.583 (e) 0.667

(f) mean < median < mode \Rightarrow negative skew

June 2007

1. (b) 2.08 (c) 0.4 (d) 0

3. (a) $X \sim \text{Po}(1.5)$ (c) 0.251 (d) 0.9889

4. (a) 0.84375

5. (b) 0.0001 (c) 0.00098 (d) 9.9
(e) 0.8699

7. (a) (ii) Mean = np , Variance = $np(1-p)$ (b) 0.9965
(c) £19940

8. (b) Mode is $x = 3$

$$(c) F(x) \begin{cases} 0 & x < 0 \\ \frac{1}{12}x^2 & 0 \leq x \leq 3 \\ 2x - \frac{1}{4}x^2 - 3 & 3 < x \leq 4 \\ \frac{1}{1} & x > 4 \end{cases}$$

(d) 2.45

January 2008

2. (a) 0.0279 (b) 0.8929 (c) 0.0140

3. (b) (i) 0.1339 (ii) 0.7149 (c) 0.149

4. (b) $\frac{203}{288}$ (c) $f(y) = \begin{cases} \frac{1}{9}(2y^3 + y) & 1 \leq y \leq 2 \\ 0 & \text{otherwise} \end{cases}$

6. (a) (i) 0.644 (ii) 0.178 (b) Normal

7. (b) Critical region: $(x \leq 3 \text{ or } x \geq 16)$ (c) 4.32%

8. (b) 3 (c) $2\frac{2}{3}$ (d) 2.71 (e) Negative

June 2008

1. (a) 5 minutes, 8.3 minutes (b) 0.2 (c) 0.00032 (d) 0.4

2. 0.9357

3. (a) CR: $X \leq 3 \cup X \geq 16$ (b) 0.0432

4. (a) $X \sim B(11000, 0.0005)$ (b) 5.5, 5.49725 (c) 0.0884

5. (a) $X \sim B(15, 0.5)$ (b) 0.1964 (c) 0.9824

6. (b) (i) 0.1708, (ii) 0.0403

7. (b) 1.406

$$(c) F(x) \begin{cases} 0 & x < 0 \\ \frac{1}{4}x^2 & 0 \leq x \leq 1 \\ \frac{1}{20}x^4 + \frac{1}{5} & 1 < x \leq 2 \\ 1 & x > 2 \end{cases}$$

(d) $= \sqrt[4]{6}$ or 1.57

January 2009

1. (a) 0.5768 (b) 0.1512
(c) $\mu = 3.69$, $\text{Var}(X) = 3.72$
(e) 0.193

2. (a) $f(x) = \begin{cases} \frac{1}{9} & -2 \leq x \leq 7 \\ 0 & \text{otherwise} \end{cases}$

(c) 13 (d) $\frac{4}{45}$ or 0.0889

3. (a) $(X \leq 2) \cup (X \geq 11)$ (b) 0.0256 or 5.26%
(c) $x = 3$ not in Critical Region $0.1071 > 0.025$; do not reject H_0

4. (b) $\frac{16}{25}$ (c) $E(T) = 6\frac{2}{3}$ $\text{Var}(T) = 5\frac{5}{9}$ (d) 10

5. (a) 0.0914 (b) 0.0043 (c) 0.809

6. (a) (i) $0.1695 > 0.10$; Critical Region $X \geq 11$; do not reject H_0
(ii) $X = 11$

7. (a) $-\frac{1}{2}x + \frac{8}{9}x - \frac{7}{9}$ (b) $F(x) = \begin{cases} 0 & x < 1 \\ -\frac{1}{9}x^2 + \frac{8}{9}x - \frac{7}{9} & 1 \leq x \leq 4 \\ 1 & x > 4 \end{cases}$
(c) $Q_1 = 1.40$

June 2009

1. (a) 0.847 (b) 0.8758

2. $P(X \leq 1) = 0.0404$; Reject H_0

4. (a) $\{X \leq 2\} \cup \{X \geq 10\}$ (b) 0.0835

5. (a) 0.8488 (b) 0.2389

6. (a) 0.4 (b) 0.064 (c) $f(y) = \frac{d}{dy}F(y) = \begin{cases} \frac{3y^2}{125} & 0 \leq y \leq 5 \\ 0 & \text{otherwise} \end{cases}$

(e) 5 (f) 3.75 (g) 0.784

7. (a) $E(X) = 2$ (b) $a = \frac{1}{4}$, $b = 1$ (d) $\sqrt{2}$

8. (a) 0.0902 (b) 0.184 (c) $e^{-\frac{2x}{15}} = 0.80$ (d) £216

January 2010

1. (a) $X \sim B(20, 0.05)$ (b) 0.3585 (c) 0.0026 (e) 0.95

2. (a) $\frac{1}{3}$ (b) $f(x) = \begin{cases} \frac{1}{6} & -2 \leq x \leq 4 \\ 0 & \text{otherwise} \end{cases}$

(c) Continuous Uniform (Rectangular) Distribution

(d) Mean = 1, Variance = 3 (e) $P(X = 1) = 0$

3. (a) 0.7788 (b) 0.3297 (c) 0.0536 (d) 0.3297

4. (b) $F(x) = \begin{cases} 0 & x \leq 0 \\ \frac{1}{27}(x^3 - 3x^2 + 6x) & 0 < x \leq 3 \\ \frac{x}{3} - \frac{1}{3} & 3 < x \leq 4 \\ 1 & x > 4 \end{cases}$ (c) $\frac{29}{12}$

5. (a) 0.3328 (b) 0.0485

6. (c) 0.85% (d) $P(x \geq 15) = 0.0169$

7. (a) 0.1875

(b) (1,1, 1), (1, 1, 2), (1, 2, 2), (2, 2, 2), (1, 2, 1) (2, 1, 1), (2, 1, 2), (2, 2, 1)

June 2010

2. (a) 0.1762 (b) 0.9804 (c) 3, 2.85 (d) 0.1847

3. $\frac{2}{3}$

4. (a) 1.26 (b) $\frac{4}{9}(2x+2)$ (c) 0.6267 (d) 0.154

5. (b) (i) 0.0003 (ii) 0.9576

6. (b) $X < 6$ and $X > 19$ (c) 0.0481

7. (b) $k = \frac{1}{9}$ (d) 2

January 2011

1. (b) 0.0317 (c) 3, 2.91 (d) 0.0839

2. $P(X \geq 4) = 0.1209 > 0.05$; teacher's claim is supported.

3. (a) 1 (b) $\frac{4}{3}$ (c) $\frac{7}{3}$ (d) 0.6 (e) 0.5605

4. $P(X \leq 3) = 0.0424 < 0.05$; Richard's claim is supported.

5. (b) $F(x) = \begin{cases} 0, & x < 0 \\ -4x^2 + 4x, & 0 \leq x \leq 0.5 \\ 1, & x > 0.5 \end{cases}$ (c) 0.146 (d) 0

(e) Positive skew (mode < median)

6. (a) $X \sim \text{Po}(2.5)$ (c) (i) 0.0821 (ii) 0.2424 (d) $m = 15$
(e) 0.01786

7. (b) 4.8 (c) 0.478 (d) 0.467

June 2011

1. (a) e.g. list of ID numbers (b) $F \sim B(50, 0.02)$

2. (a) Poisson (c) 11

3. (a) mode = 3 (b) $k = \frac{1}{18}$ (c) $a = 5$ (d) $E(X) < 3$

4. (a) $\frac{5}{6}$ (b) $\frac{91}{216}$ (c) $\frac{1}{625}$

5. (a) 0.2650 (b) 0.4987 (c) 0.01123

7. (b) $E(X) = 3$ (d) 0.8944 (e) $a = 7$ (g) 3.7 (h) 0.78

January 2012

1. (b) 6 minutes (b) 3 minutes (c) $\frac{1}{3}$ (d) $\frac{2}{5}$

2. Evidence suggests David's claim is incorrect.

3. (a) 0.197 (b) 0.352 (c) 33 or 34 (d) 19

4. (a) Poisson (c) 0.0181 (d) 0.0835 (e) 0.0019

5. (a) 0.979 (b) 0.958

6. (c)
$$F(x) = \begin{cases} 0 & x < 0, \\ \frac{1}{2}x & 0 \leq x < 1, \\ \frac{1}{2}x^2 - \frac{1}{2}x + \frac{1}{2} & 1 \leq x \leq k, \\ 1 & x > k \end{cases} \quad (d) 0.625$$

(e) median = 1, mode = $\frac{1}{2}(1 + \sqrt{5})$ (f) negative skew

7. (b) (i) $[0, 3]$ (ii) 0.0424

(c) Evidence suggests the estate agent's claim is incorrect.

June 2012

1. (a) 0.4 (b) 0.584 (c) 0.341

2. (a) $X \leq 7 \cup X \geq 18$ (b) 0.0432

3. (a) $n > 50, p < 0.2$

4. (a) (i) 0.0286 (ii) 0.809 (b) 0.228 (c) 0.109

5. (b) 2 (c) 0.8 (d) 0.633

6. 0.3175, 0.6925

7. (b)
$$f(x) = \begin{cases} \frac{x^3}{135} & 0 \leq x \leq 3, \\ \frac{x}{5} - \frac{2}{5} & 3 < x < 4, \\ \frac{x}{3} - \frac{x^2}{60} - \frac{2}{3} & 4 \leq x \leq 10, \\ 1 & x > 10. \end{cases}$$

January 2013

1. (a) n large, p small (b) $P(X \geq 4) = 0.9897$

2. (a) (i) $P(X = 7) = 0.0216$ (ii) $P(X \geq 4) = 0.3528$
(b) $P(X < 20) = 0.0274$

3. (a) (i) $P(X < 5) = 0.8424$ (ii) $P(X \geq 7) = 0.0143$
(b) $p = 0.221$ (c) $p = 0.2$ or 0.8

4. (a) Mean = 1 (b) $P(X \leq 2.4) = 0.64$

$$(c) P(-3 < X - 5 < 3) = 0.4 \quad (e) \text{Var}(Y) = \frac{3}{4}a^2 \quad (f) a = \frac{8}{9}$$

$$5. \quad (b) P(T < 3) = 0.306 \quad (c) P(T > 8 \mid T > 3) = 0.6125$$

(d) $t = 32.4$ days

$$6. \quad (c) \text{There is no evidence that the proportion who voted for Mrs George is not 45\%}$$

(d) smallest value of $n = 8$

$$7. \quad (b) 30a + 100b = 7 \quad (c) a = 0.1, b = 0.04$$

(d) $m = 3.09$ (e) negatively skewed

June 2013 (R)

$$1. \quad (a) (1,1,1); (5,5,5); (1, 5, 5); (5, 1, 5); (5, 5, 1) (5, 1, 1); (1, 5, 1); (1, 1, 5)$$

$$(b) P(R = 0) = \frac{1}{3}, P(R = 4) = \frac{2}{3}$$

$$2. \quad (a) k = 6 \quad (b) f(y) = \begin{cases} \frac{1}{4}(3y^2 - 8y + 6) & 0 \leq y \leq 2 \\ 0 & \text{otherwise} \end{cases} \quad (c) \frac{1}{4}$$

$$3. \quad (a) a = 8, b = 38 \quad (b) 0.18$$

$$4. \quad (b) \text{mode} = 1 \quad (c) \frac{5}{4} \quad (d) \text{positive skew}$$

$$5. \quad (a) 0.168 \quad (b) 0.0426 \quad (c) 0.3$$

(d) 0.163 (e) 0.241

$$6. \quad (a) X \leq 3, X \geq 14 \quad (b) 0.0766 \quad (c) 0.053$$

$$7. \quad (a) X \sim B(20, 0.2) \quad (c) E(S) = 0, \text{Var}(S) = 80$$

(d) 0.0321 (e) 0.016

June 2013

$$1. \quad (a) (5,5,5) \text{ and } (5,5,1) (\times 3) \text{ and } (5,5,2) (\times 3)$$

$$(b) P(M = 5) = \frac{27}{125} \quad (c) P(M = 1) = 0.5, P(M = 2) = \frac{71}{250}$$

$$2. \quad (a) 0.195 \quad (b) 0.191 \quad (c) 0.953$$

$$3. \quad (a) 0.0985 \quad (b) 12 \quad (c) \text{No evidence of increase}$$

$$4. \quad (a) \frac{5b}{2} \quad (c) 3b^2 \quad (d) F(x) = \begin{cases} 0 & x < 3 \\ \frac{x-1}{3} & 1 \leq x \leq 4 \\ 1 & x > 4 \end{cases}$$

(e) $x = 2.5$

$$5. \quad (a) a = -\frac{3}{5}, b = \frac{1}{5} \quad (c) \frac{13}{8}$$

$$6. \quad (a) X \leq 1 \cup 10 \leq X \quad (b) \text{No evidence}$$

$$7. \quad (a) X \sim B(n, 0.1) \quad (b) 0.0128 \quad (c) n = 29 \quad (d) 0.0137$$

June 2014(R)

2. (a) (i) S is a statistic (ii) D is not a statistic (iii) F is a statistic
 (b) $T \sim B(10, 0.4)$ (c) 0.144
3. (a) $X \sim \text{Po}(9)$ (b) 0.6761
 (c) 0.777 (3 dp) (d) 0.272
4. (b) mode = 2 (c) negative skew (d) $k = \frac{1}{12}$
 (e) Lower Quartile = 1 (f) $\frac{5}{36}$
5. (a) $X \leq 1$ or $X \geq 10$ (b) 0.0722 (c) $x = 35.3$
6. (a) 1.08 (b) $-\frac{6d}{4} < 0$ so max (c) 35
7. (a) $X \sim U[0, 9]$ (b) 0.333 (c) $9X - X^2$
 (d) 13.5 (e) $\frac{1}{3}$

June 2014

1. (a) (i) 0.1171 (ii) 0.4126
 (b) 0.7769
2. (c) $\frac{14}{27}$ (d) $\frac{25}{189}$ (e) $\frac{2548}{6561}$

3. (b) CR $X = 9$, $X \geq 9$ (c) 0.0397 (e) Fewer emails are received.

4. (a) (i) 0.145998 (ii) 0.52559
 (b) $x = 85$
 (c) 0.958

5. (d) The company's claim is justified

6. (a) $2\frac{7}{9}$ (b) $F(x) = \int_4^x \frac{2}{3} - \frac{x}{9} dx + \frac{7}{9}$ (c) $m = 2.75$